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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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09/427,238

10/26/1999

SHARAD KAPUR

KAPUR5-10

2915

27964

7590

11/04/2003

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EXAMINER

GARCIA OTERO, EDUARDO

ART UNIT

PAPER NUMBER

2123

21

DATE MAILED: 11/04/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/427,238

Applicant(s)

KAPUR ET AL.

Examiner

Eduardo Garcia-Otero

Art Unit

2123

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 13 August 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-21 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-21 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ 6) ☐ Other: _____

EXAMINATION: Final Action

Introduction

1. Title is: SYSTEM AND METHOD FOR DETERMINING CAPACITANCE FOR LARGE-SCALE INTEGRATED CIRCUITS
2. Applicant is: KAPUR et al.
3. US Application filed 10/26/99, no domestic or foreign priority claimed.
4. Claims 1-21 have been submitted, examined, and rejected.
5. This action is in response to Amendments filed 8/13/03.
6. The amendments are accepted without objection. Claims 1, 8, and 15 are currently amended.
7. This is the second action on the merits after RCE, and is final
8. There are no objections to drawings, specification, or claims, because all previous objections have been withdrawn.
9. Second, the specification has been substantially modified several times, and the
10. The Examiner requests a substitute specification incorporating all past as well as all new changes, because the specification has been substantially modified many times.

Index

11. **Belk** refers to Belk, US Patent 6,397,171 filed Apr. 1, 1999.
12. **Nabors** refers to PRECONDITIONED, ADAPTIVE, MULTIPOLE-ACCELERATED ITERATION METHODS FOR THREE-DIMENSIONAL FIRST-KIND INTEGRAL EQUATIONS OF POTENTIAL THEORY", K. Nabors et al, Siam Journal on Scientific Computing, Vol. 15, No. 3, pp. 713-735, May 1994.
13. **Edgecombe** refers to Edgecombe et al., US Patent 6,345,235 filed
14. **Dufour** refers to Dufour, US Patent 6,351,572.

Applicant Remarks

15. ENABLEMENT, CLAIMS 1-21. Remarks page 11. Applicant respectfully disagrees with the enablement rejections, and states that the claims, the specification, and Figure 2B have been amended to more clearly provide enablement. However, Applicant has not amended the term which has been rejected as not enabled, specifically "**multidimensional charge variation function that is independent of a conductive geometry of said structure**". Nor

Art Unit: 2123

has Applicant specifically addressed how the amendments provide enablement. The enablement rejections are maintained, and modified slightly in view of the amendments.

16. 35 USC 102(e), CLAIMS 1-8. Remarks page 11-12. Applicant unpersuasively distinguishes the claimed invention from Belk, stating that the charge variation may be generated by employing equations 10-16. However, claims 1 and 8 do not explicitly include equations 10-16. Thus, Applicant's assertions are unpersuasive.
17. 35 USC 103, CLAIMS 2-7 AND 9-21. Remarks page 13-15. Regarding independent claim 15, see above discussion regarding independent claims 1 and 8. Regarding claims 2-7, and 9-14, and 16-21, the Applicant unpersuasively asserts that the dependent claims are allowable because the base independent claims are allowable.

Claim Interpretation

18. The term “**integral equation formulation**” is broadly interpreted to mean any description of capacitance which includes or is derived from at least one integral equation.
19. Note that the rejections below are based upon Specification FIG 2 as previously amended.

35 USC § 112-first paragraph (Enablement)

20. The following is a quotation of the first paragraph of 35 U.S.C. 112: The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.
21. **Claims 1-21 are rejected under 35 U.S.C. 112, first paragraph, as not enabled**, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.
22. Specifically, independent claims 1 (currently amended), 8 (currently amended), and 15 (currently amended) all state “**multidimensional charge variation function that is independent of a conductive geometry of said structure**”.
23. Note that the terms charge distribution and charge variation appear to be used interchangeably, see elements 260 and 270 and 280.

Art Unit: 2123

24. In FIG 2B, the “first charge variation function” (element 265) is determined based upon the “initial charge distribution and representative geometry” (element 260). The representative geometry appears to be based upon the original geometry, and thus is dependent upon the original geometry.
25. Note that “create a variation function to refine a description of the charge distribution function” (element 280) may be determined based upon “subdivide geometry into subdivisions (element 290). Thus, both the initial and the refined charge variation functions (or charge distribution functions) are not independent of the conductive geometry of said structure. Rather, the initial and the refined charge variation functions are directly dependent upon the initial geometry, and the refined charge variation function may be dependent upon the subdivided geometry.
26. Note that the present invention does not enable a charge variation function independent of a conductive geometry, and all claims are rejected as not enabled for this reason.
27. Additionally, even if “independent of a conductive geometry” is interpreted to mean “derived from the conductive geometry” (which appears to be the intention of the present application), then Belk does teach a charge variation function that is “derived from the conductive geometry”.

Claim Rejections - 35 USC § 102(e)

28. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:
29. A person shall be entitled to a patent unless –
30. (e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.
31. The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) do not apply to the examination of this application as the application being examined was not (1) filed on or after November 29, 2000, or (2) voluntarily published under 35 U.S.C. 122(b). Therefore, this application is examined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

Art Unit: 2123

32. Claims 1 (currently amended), and 8 (currently amended) are rejected under 35 U.S.C. 102(e).

33. Claim 1 (currently amended) is rejected under 35 U.S.C. 102(e) as being anticipated by Belk.

34. Claim 1 (currently amended) is an independent claim with 2 limitations

35. a charge variation function generator that creates a multidimensional charge variation function that is independent of a conductive geometry of said structure is disclosed by Belk “charge distributions” at Column 12 line 33.

36. a conductive geometry generator, associated with said charge variation generator, that creates a representative conductive geometry, wherein said charge variation function is projected on said representative conductive geometry to provide said representation, said charge variation function and said representative conductive geometry employable in said integral equation formulation to reduce a complexity thereof disclosed by Belk “decompose metalization structures into representative sub units” at Column 2 line 65-66.

37. Claim 8 (currently amended) is rejected under 35 U.S.C. 102(e) as being anticipated by Belk.

38. Claim 8 (currently amended) is an independent “method” claim with the same limitations as “system” Claim 1 (amended), and therefore is rejected for the same reasons.

Claim Rejections - 35 USC § 103

39. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

40. A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

41. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

Determining the scope and contents of the prior art.

Ascertaining the differences between the prior art and the claims at issue.

Art Unit: 2123

Resolving the level of ordinary skill in the pertinent art.

Considering objective evidence present in the application indicating obviousness or nonobviousness.

42. **Claims 2-7, and 9-21 are rejected under 35 U.S.C. 103(a) as being unpatentable.**

43. **Claim 2 is rejected** under 35 U.S.C. 103(a) as being unpatentable over Belk in view of Stalzer.

44. Claim 2 depends from Claim 1, with one additional limitation.

45. Belk does not expressly disclose the additional limitation:

46. **Fast Distributed Method (FDM)** is disclosed by Stalzer at Column 1 line 15 Fast Multipole Method and at Column 2 line 13 “cube”.

47. **At the time** the invention was made, it would have been obvious to a person of ordinary skill in the art to use Stalzer to modify Belk. One of ordinary skill in the art would have been motivated to do this because “two dimensional or quasi two dimensional processes...yield very inaccurate results” according to Belk Column 1 lines 38-41.

48. **Claim 3 is rejected** under 35 U.S.C. 103(a) as being unpatentable over Belk in view of Nabors.

49. Claim 3 depends from Claim 1, with one additional limitation.

50. Belk does not expressly disclose the additional limitation:

51. **charge variation function is a three-dimensional function** is disclosed by Nabors at Abstract “three-dimensional, first-kind, integral equations that arise in potential theory”.

At the time the invention was made, it would have been obvious to a person of ordinary skill in the art to use Nabors to modify Belk. One of ordinary skill in the art would have been motivated to do this because “two dimensional or quasi two dimensional processes...yield very inaccurate results” according to Belk Column 1 lines 38-41. Furthermore, all real charge distributions are three dimensional.

52. **Claim 4 is rejected** under 35 U.S.C. 103(a) as being unpatentable over Belk in view of Edgecombe.

53. Claim 4 depends from Claim 1, with one additional limitation.

54. Belk does not expressly disclose the additional limitation:

Art Unit: 2123

55. **charge variation function is a smooth function of spatial location** is disclosed by Edgecombe at Column 12 line 32 “smooth function”.

56. **At the time** the invention was made, it would have been obvious to a person of ordinary skill in the art to use Edgecombe to modify Belk. One of ordinary skill in the art would have been motivated to do this because “The preferred principal characteristics that we want in our interpolant are robustness and smoothness” according to Edgecombe Column 12 line 36.

57. **Claim 5 (amended) is rejected** under 35 U.S.C. 103(a) as being unpatentable over Belk in view of Nabors.

58. Claim 5 (amended) depends from Claim 1, with one additional limitation.

59. Belk does not expressly disclose the additional limitation:

60. **conductive geometry generator iteratively creates said representative conductive geometry** is disclosed by Nabors at Abstract “iterative”.

61. **At the time** the invention was made, it would have been obvious to a person of ordinary skill in the art to use Nabors to modify Belk. One of ordinary skill in the art would have been motivated to do this “because the accelerated method is substantially faster than standard algorithms” according to Nabors Abstract.

62. **Claim 6 is rejected** under 35 U.S.C. 103(a) as being unpatentable over Belk in view of Nabors.

63. Claim 6 depends from Claim 1, with one additional limitation.

64. Belk does not expressly disclose the additional limitation:

65. **said charge variation function generator employs a generalized minimal residual-based Krylov method to determine said multidimensional charge variation function** is disclosed by Nabors at Abstract “Krylov-subspace iterative algorithm”.

66. **At the time** the invention was made, it would have been obvious to a person of ordinary skill in the art to use Nabors to modify Belk. One of ordinary skill in the art would have been motivated to do this “because the accelerated method is substantially faster than standard algorithms” according to Nabors Abstract.

67. **Claim 7 (amended) is rejected** under 35 U.S.C. 103(a) as being unpatentable over Belk in view of Dufour.

68. Claim 7 (amended) depends from Claim 1, with one additional limitation.

Art Unit: 2123

69. Belk does not expressly disclose the additional limitation:

70. **said representative conductive geometry is represented in an octtree** is disclosed by Dufour at Column 2 line 6 “octree subdivision of the 3D space”.

71. **At the time** the invention was made, it would have been obvious to a person of ordinary skill in the art to use Dufour to modify Belk. One of ordinary skill in the art would have been motivated to do this because “octrees are an efficient representation for many volumetric objects since there is a large degree of coherence between adjacent voxels in a typical object” according to Dufour at Column 2 line 14.

72. **Claim 9-14 are rejected** under 35 U.S.C. 103(a).

73. Claims 9-14 are “method” claims with the same limitations as “system” Claims 2-7, and therefore are rejected for the same reasons.

74. **Claim 15 (currently amended) is rejected** under 35 U.S.C. 103(a) as being unpatentable over Belk in view of Nabors.

75. Claim 15 (currently amended) is an independent claim with 3 limitations.

76. **1-a charge variation function generator that creates a multidimensional charge variation function that is independent of a conductive geometry of said integrated circuit** is disclosed by Belk “charge distributions” at Column 12 line 33.

77. **2- a conductive geometry generator, associated with said charge variation generator, that creates a representative conductive geometry, wherein said charge variation function is projected on said representative conductive geometry to provide said representation, said charge variation function and said representative conductive geometry employable in said integral equation formulation to reduce a complexity thereof** disclosed by Belk “decompose metalization structures into representative sub units” at Column 2 line 65-66.

78. Belk does not expressly disclose the third limitation:

79. **3-an integral equation formulator, associated with said charge variation generator and conductive geometry generator, that determines said capacitance of said integrated circuit** is disclosed by Nabors at Abstract “integral equations”.

80. **At the time** the invention was made, it would have been obvious to a person of ordinary skill in the art to use Nabors to modify Belk. One of ordinary skill in the art would have been

Art Unit: 2123

motivated to do this “because the accelerated method is substantially faster than standard algorithms” according to Nabors Abstract.

81. **Claim 16 is rejected** under 35 U.S.C. 103(a) as being unpatentable over Belk in view of Nabors and Stalzer.

82. Claim 16 depends from Claim 15, with one additional limitation.

83. Belk does not expressly disclose the additional limitation:

84. **Fast Distributed Method (FDM)** is disclosed by Stalzer at Column 1 line 15 Fast Multipole Method and at Column 2 line 13 “cube”.

85. **At the time** the invention was made, it would have been obvious to a person of ordinary skill in the art to use Stalzer to modify Belk. One of ordinary skill in the art would have been motivated to do this because “two dimensional or quasi two dimensional processes...yield very inaccurate results” according to Belk Column 1 lines 38-41.

86. **Claim 17 is rejected** under 35 U.S.C. 103(a) as being unpatentable over Belk in view of Nabors.

87. Claim 17 depends from Claim 15, with one additional limitation.

88. Belk does not expressly disclose the additional limitation:

89. **charge variation function is a three-dimensional function** is disclosed by Nabors at Abstract “three-dimensional, first-kind, integral equations that arise in potential theory”. **At the time** the invention was made, it would have been obvious to a person of ordinary skill in the art to use Nabors to modify Belk. One of ordinary skill in the art would have been motivated to do this because “two dimensional or quasi two dimensional processes...yield very inaccurate results” according to Belk Column 1 lines 38-41, and “because the accelerated method is substantially faster than standard algorithms” according to Nabors Abstract.

90. **Claim 18 is rejected** under 35 U.S.C. 103(a) as being unpatentable over Belk in view of Nabors and Edgecombe.

91. Claim 18 depends from Claim 15, with one additional limitation.

92. Belk does not expressly disclose the additional limitation:

93. **charge variation function is a smooth function of spatial location** is disclosed by Edgecombe at Column 12 line 32 “smooth function”.

Art Unit: 2123

94. **At the time** the invention was made, it would have been obvious to a person of ordinary skill in the art to use Nabors and Edgecombe to modify Belk. One of ordinary skill in the art would have been motivated to do this because “The preferred principal characteristics that we want in our interpolant are robustness and smoothness” according to Edgecombe Column 12 line 36, and “because the accelerated method is substantially faster than standard algorithms” according to Nabors Abstract.

95. **Claim 19 (amended) is rejected** under 35 U.S.C. 103(a) as being unpatentable over Belk in view of Nabors.

96. Claim 19 (amended) depends from Claim 19, with one additional limitation.

97. Belk does not expressly disclose the additional limitation:

98. **conductive geometry generator iteratively creates said representative conductive geometry** is disclosed by Nabors at Abstract “iterative”.

99. **At the time** the invention was made, it would have been obvious to a person of ordinary skill in the art to use Nabors to modify Belk. One of ordinary skill in the art would have been motivated to do this “because the accelerated method is substantially faster than standard algorithms” according to Nabors Abstract.

100. **Claim 20 is rejected** under 35 U.S.C. 103(a) as being unpatentable over Belk in view of Nabors.

101. Claim 20 depends from Claim 15, with one additional limitation.

102. Belk does not expressly disclose the additional limitation:

103. **said charge variation function generator employs a generalized minimal residual-based Krylov method to determine said multidimensional charge variation function** is disclosed by Nabors at Abstract “Krylov-subspace iterative algorithm”.

104. **At the time** the invention was made, it would have been obvious to a person of ordinary skill in the art to use Nabors to modify Belk. One of ordinary skill in the art would have been motivated to do this “because the accelerated method is substantially faster than standard algorithms” according to Nabors Abstract.

105. **Claim 21 (amended) is rejected** under 35 U.S.C. 103(a) as being unpatentable over Belk in view of Dufour and Nabor.

106. Claim 21 (amended) depends from Claim 15, with one additional limitation.

Art Unit: 2123

107. Belk does not expressly disclose the additional limitation:
108. **said representative conductive geometry is represented in an octtree** is disclosed by Dufour at Column 2 line 6 “octree subdivision of the 3D space”.
109. **At the time** the invention was made, it would have been obvious to a person of ordinary skill in the art to use Dufour and Nabor to modify Belk. One of ordinary skill in the art would have been motivated to do this because “octrees are an efficient representation for many volumetric objects since there is a large degree of coherence between adjacent voxels in a typical object” according to Dufour at Column 2 line 14.

Conclusions and Suggestions

110. All claims stand rejected.
111. It is not clear whether or not the original disclosure contains potentially allowable material. The Examiner suggests the following procedure if a Request for further Examination is made.
112. First, the charge distribution appears dependent upon the simplified geometry, and the simplified (or representative) geometry is based upon (or derived from, or refined from) the original geometry. Limitations stating independence from the original conductive geometry are not enabled. Perhaps the term “not directly dependent” may indicate the Applicant’s intent.
113. Second, the specification has been substantially modified several times, and the Examiner requests a substitute specification incorporating all past as well as all new changes.
114. Third, the specification should be carefully reviewed to insure a consistent use of terminology.
115. Fourth, a new flow chart should be added to the drawings, to indicate precisely which equations are being used at which steps in order to solve for which variables. At present, this is far from clear. Possibly an existing flow chart could be modified to satisfy this request.
116. Fifth, new claims should be written, preferably incorporating the relevant equations in order to avoid 35 USC 112 rejections.
117. The Examiner notes that the subject matter is both difficult and complex, and that there is substantial closely related prior art, and therefore the specification and figures and claims must be very clear in order to disclose and claim any potentially allowable material.

Art Unit: 2123

Communication

118. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Eduardo Garcia-Otero whose telephone number is 703-305-0857. The examiner can normally be reached on Monday through Thursday from 9:00 AM to 7:00 PM.
119. If attempts to reach the Examiner by telephone are unsuccessful, the Examiner's supervisor, Kevin Teska, can be reached at (703) 305-9704. The fax phone numbers for this group are:
120. (703) 746-7238 --- for communications after a Final Rejection has been made;
121. (703) 746-7239 --- for other official communications; and
122. (703) 746-7240 --- for non-official or draft communications.
123. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the group receptionist, whose telephone number is (703) 305-3900.

* * * *



KEVIN J. TESKA
SUPERVISORY
PATENT EXAMINER